

# Three Way Multi Model Interoperation

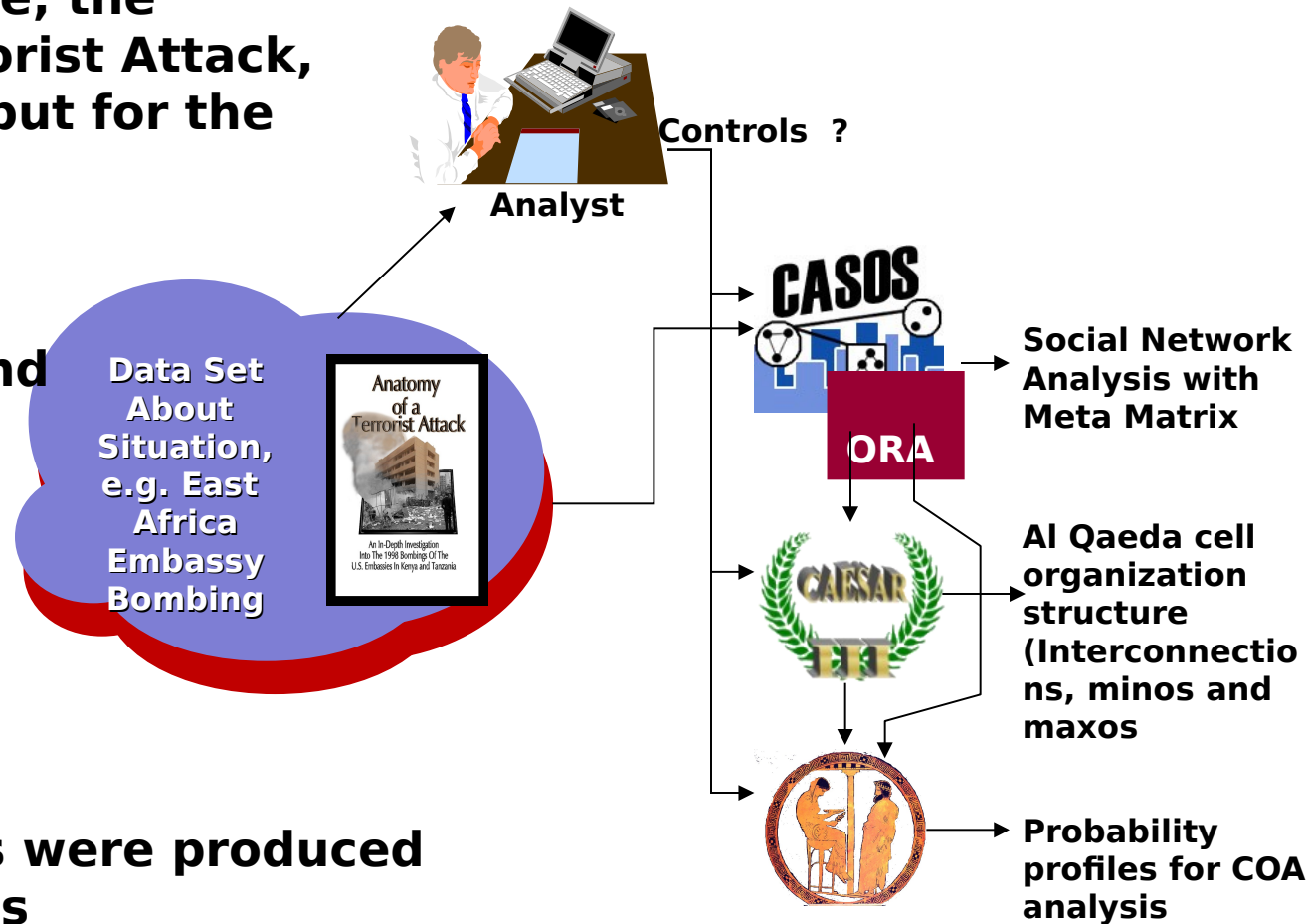
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Adversary Behavioral Modeling  
Maxwell AFB, Montgomery AL  
March 18 - 19, 2008

- **A process and interoperation technique for using three modeling tools (ORA, CASEAR III, and Pythia) has been demonstrated using the East Africa Embassy Bombing (1998) as an example**
- **Outline**
  - **Approach**
  - **Models**
  - **Results**

- **With respect to the suite of models available from CASOS, CSC, and SAL the question of how data or information can be passed between the models is unknown or un-proven.**
- **A Limited Discovery Experiment was used to explore the potential interoperation between modeling techniques to determine if:**
  - 1) interoperation is possible,**
  - 2) various interoperation types can be applied**
  - 3) use of such interoperation would improve the overall analysis over that provided by the models independently.**
- **A case study approach was taken using a corpus of data about the al Qaeda Bombings of the Embassy in Kenya.**

- A single data source, the **Anatomy of a Terrorist Attack**, was used as the input for the **Demonstration**
- The information in the document was fed into the **CASOS** tool via **Automap** and edited by the analysts who used read the data set
- Outputs from **ORA** were used to create **CAESAR III** and **Pythia** models
- Analytical products were produced from the three tools

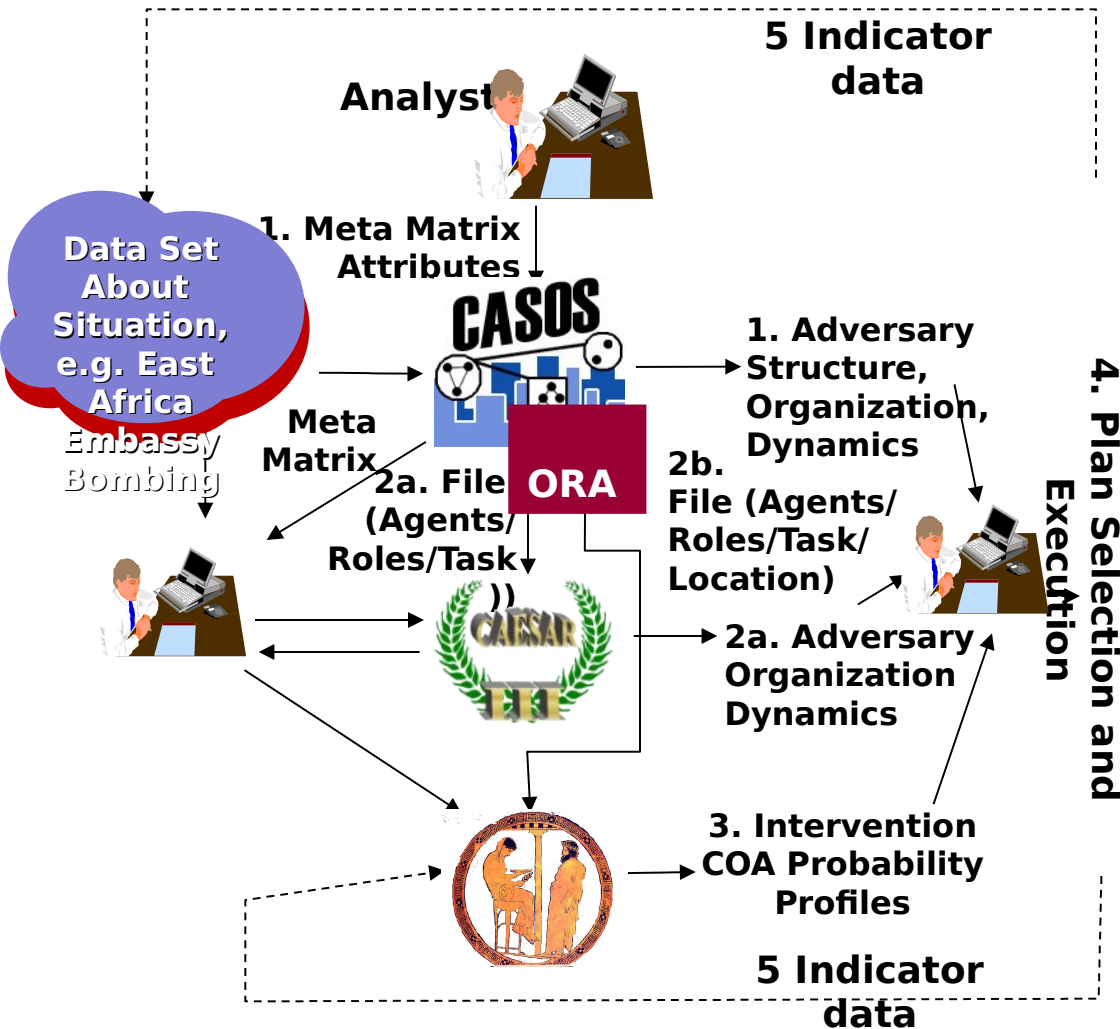


# Types of Interoperation



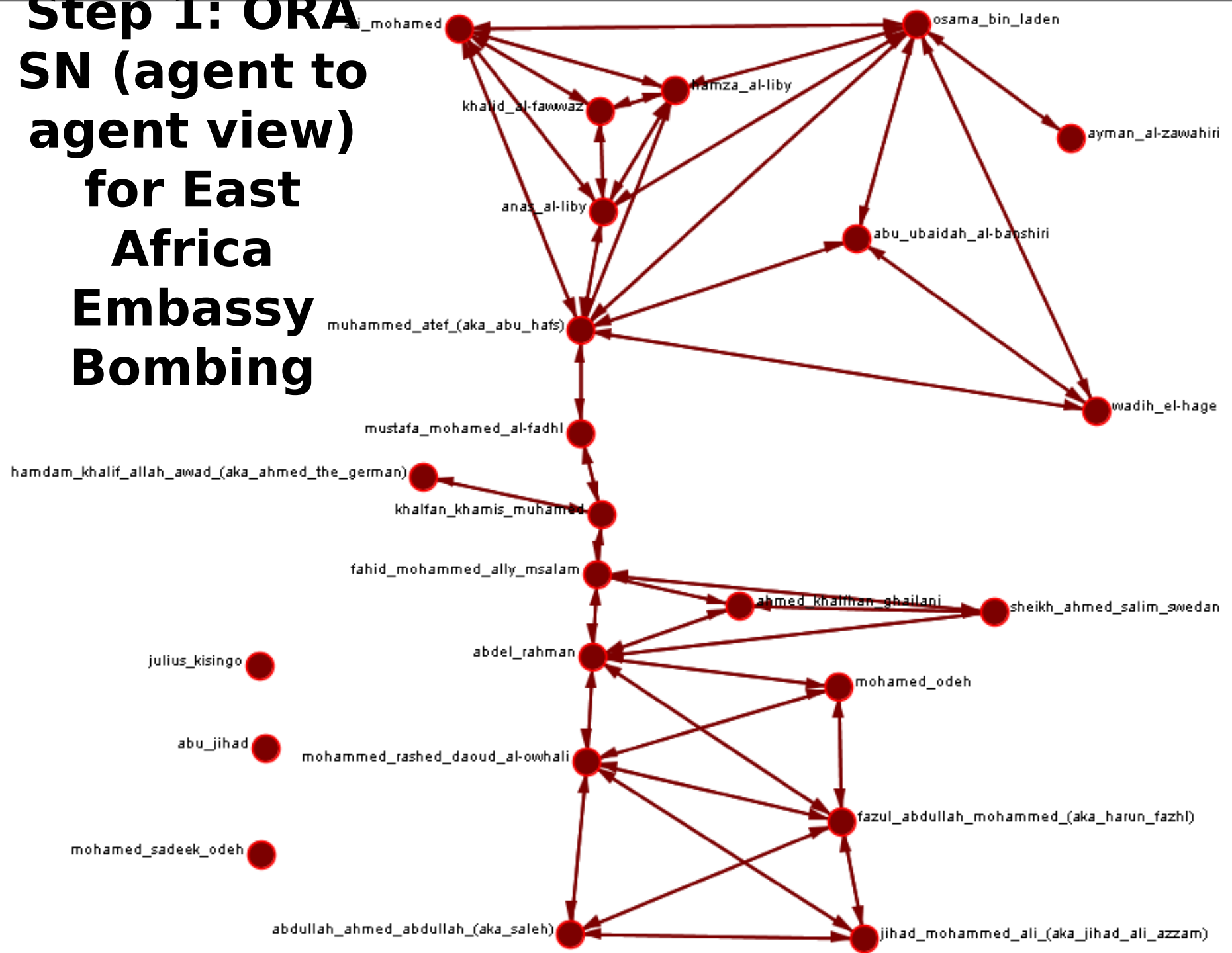
- The basic proposition: Understanding of an adversary and analysis of Effects based Courses of Action can be improved by using these multiple models by **exchanging information or data between them.**
- Three types of interoperation have been postulated
  - Human to human (Swivel Chair) (Human gains insights from model 1 that helps with the human set up or analysis of model 2)
  - Data to Data (files can be exported from one model that can be “read” automatically by another model under the direction of the analyst)
  - Automated Model to Model (Model can be connected over a network and automatically exchange data as they are “run”)

# Experiment (Interoperation) Process Example

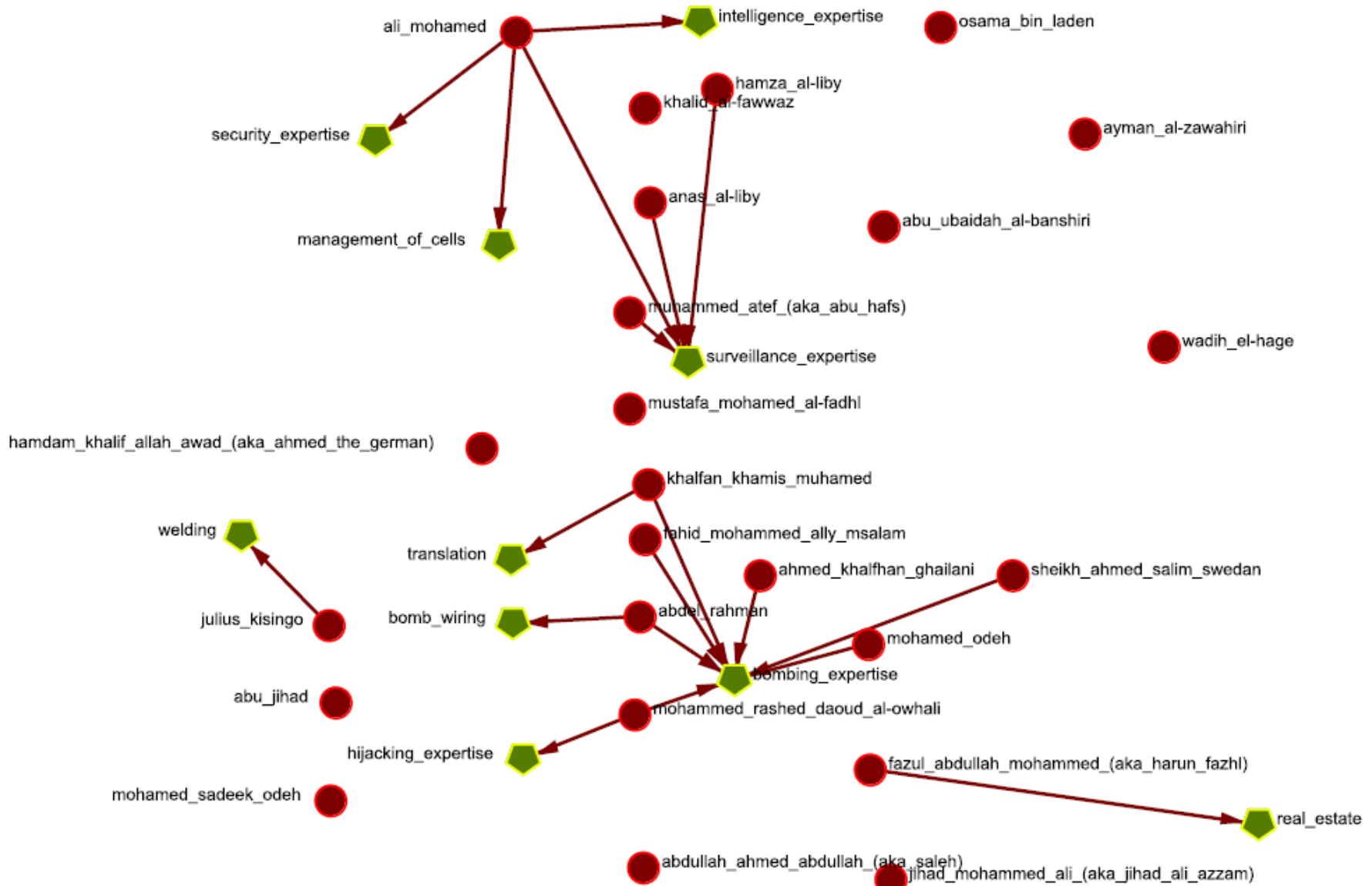


1. Analyst sets up **Automap** and Runs **ORA** generating **Meta Matrix and XML File** for CAESAR 3 and Pythia
- 2a. **CAESAR III** analyst uses ORA file plus knowledge from Data Set to **generate adversary organization models** (lattice plus CP net). Identifies potential communications links for ISR
- 2b. The analyst loads ORA file into **Pythia** and refines the model using ORA Meta Matrix in Pythia
3. Analyst uses TIN to produce probability profiles, **comparing COAs for selection.**
4. COA is selected, planned, and executed including ISR Tasking
5. Indicator data from ISR used to update Data Set and Pythia for on-going Assessment

# Step 1: ORA SN (agent to agent view) for East Africa Embassy Bombing

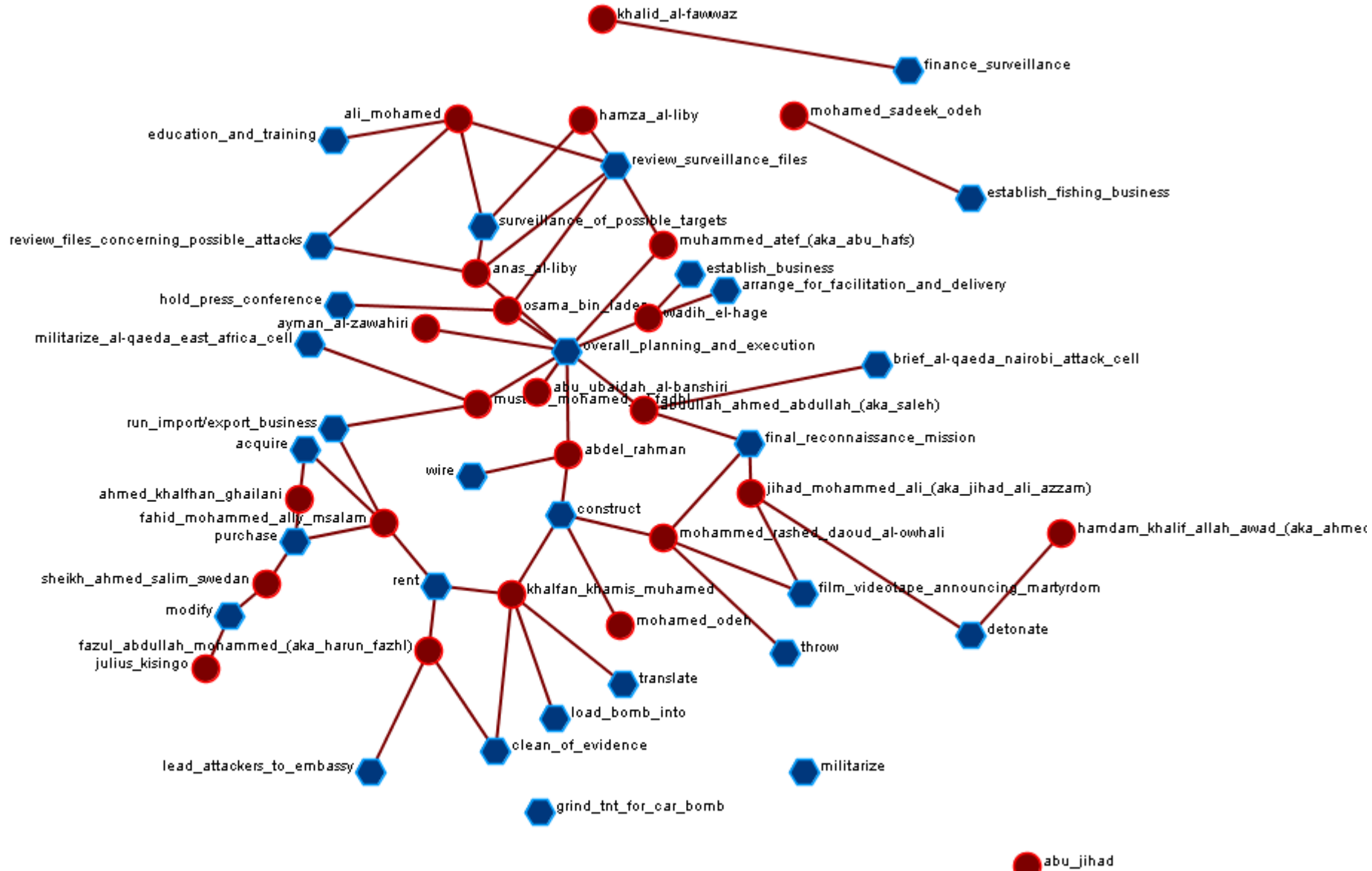


# ORA Agents to Knowledge



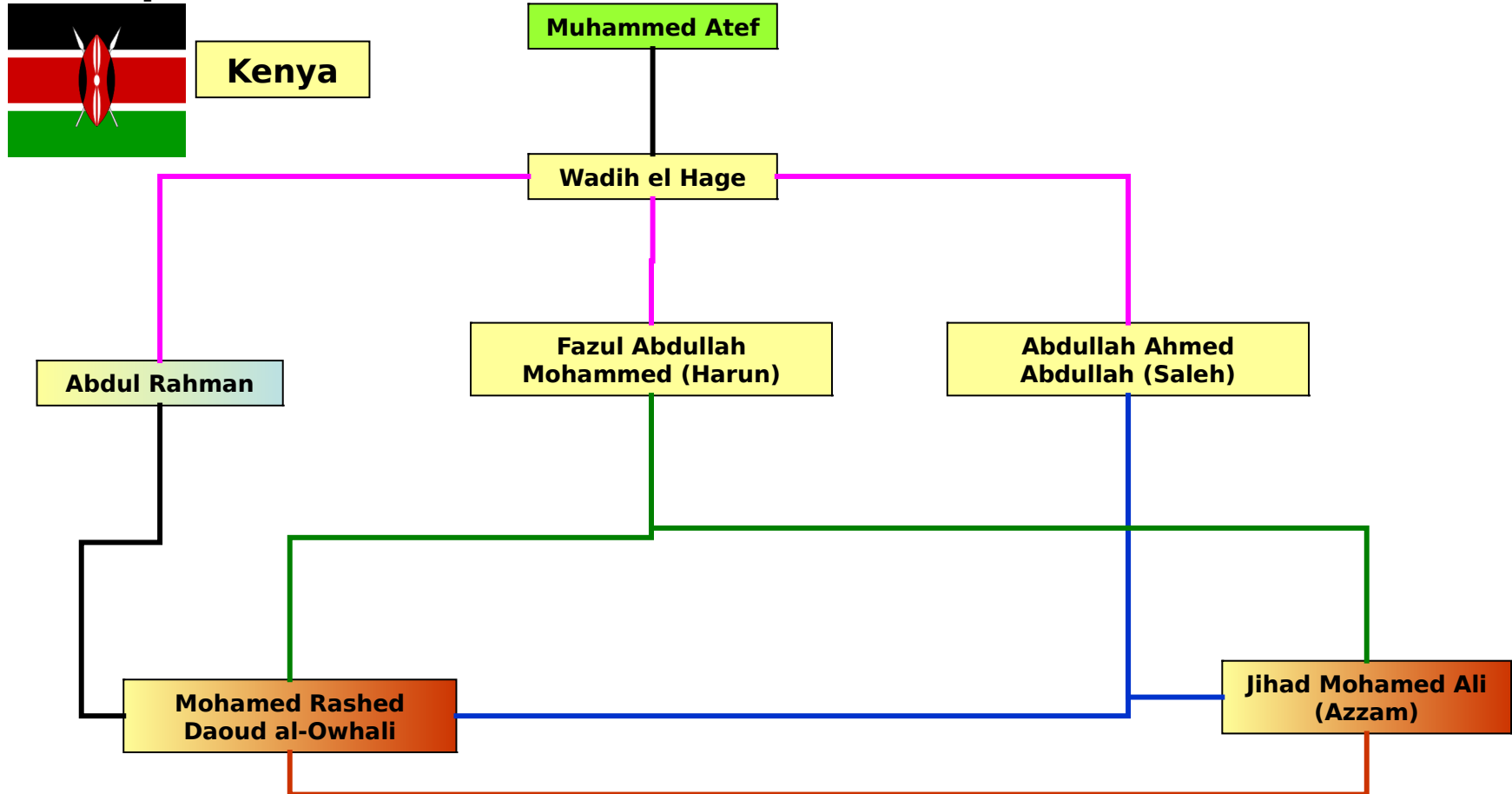


# Step 1: ORA SN (agent to Task view) for East Africa Embassy Bombing



# The Kenya Team

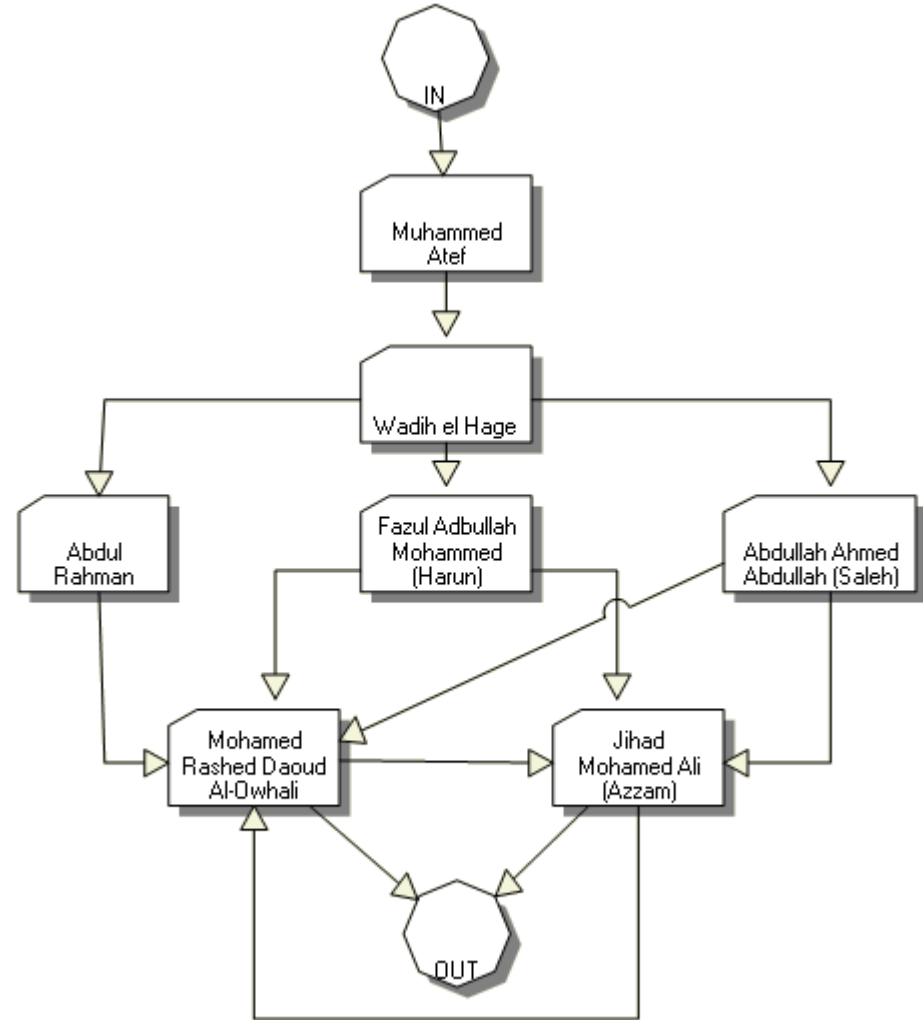
The following command structure was inferred from reports (text) and ORA meta matrix



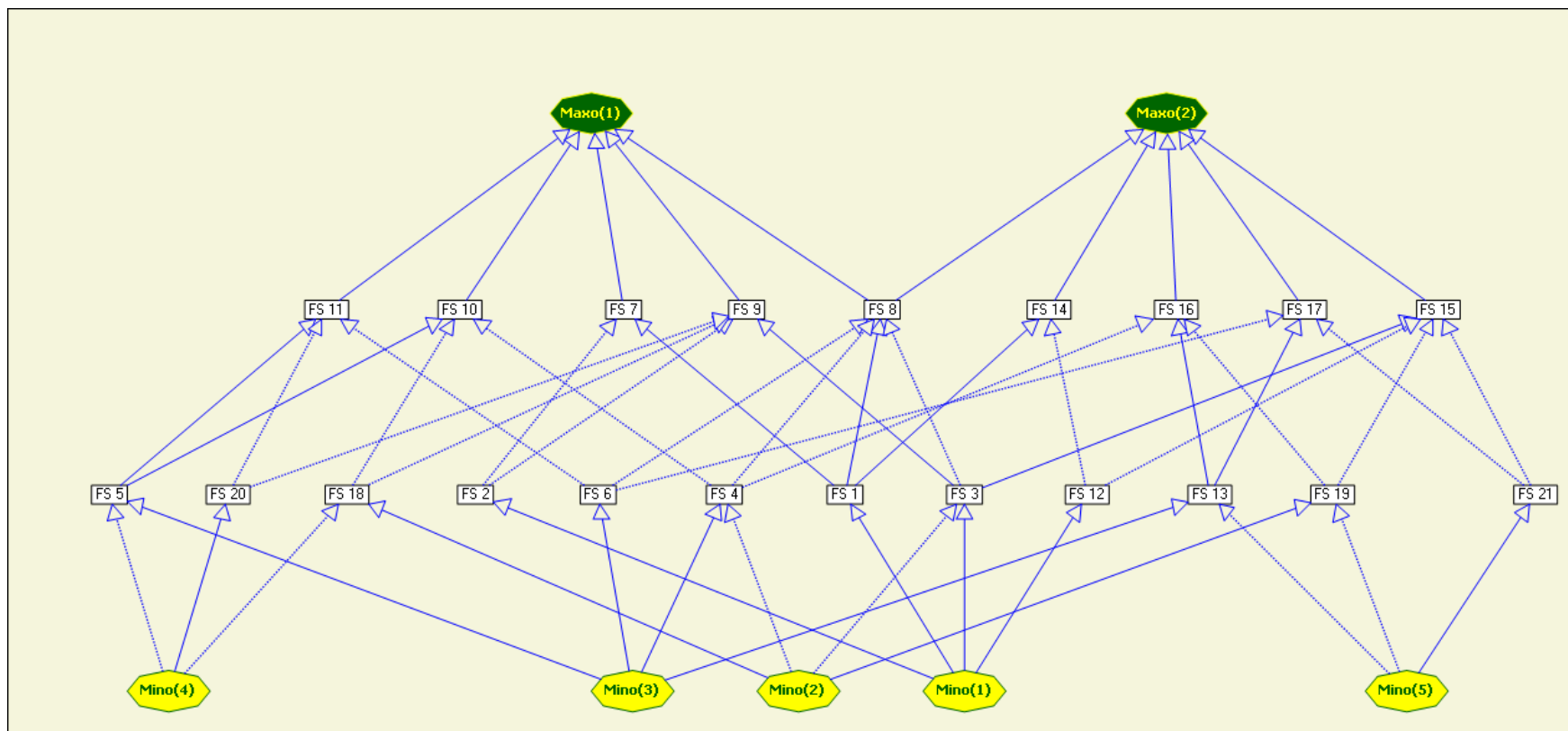
# The Kenya Team



- The same representation in CAESAR III



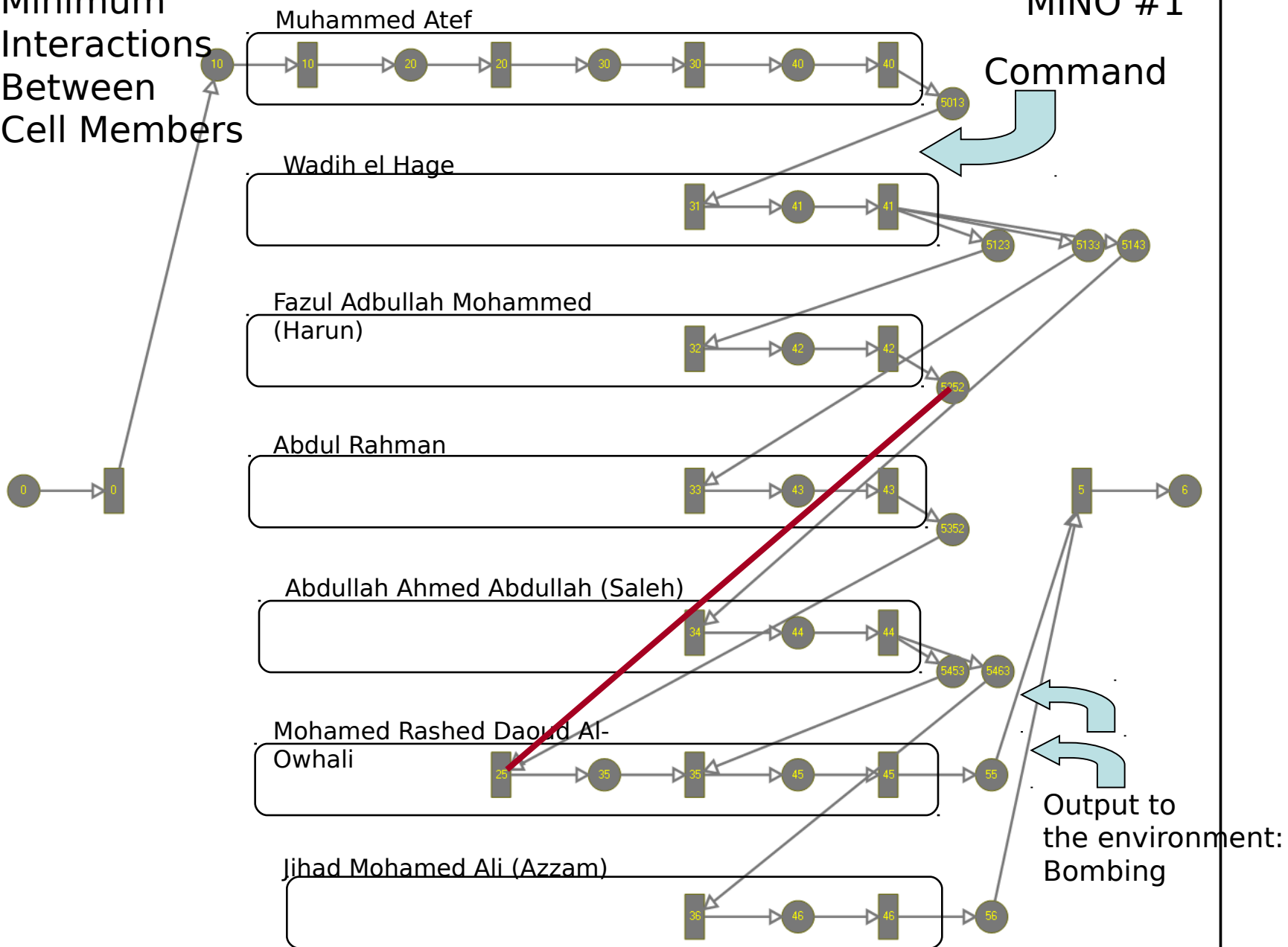
- **Lattice Algorithm reveals all possible organizational structures (28) of the Al Qaeda Kenya cell**



Minimum  
Interactions  
Between  
Cell Members

MINO #1

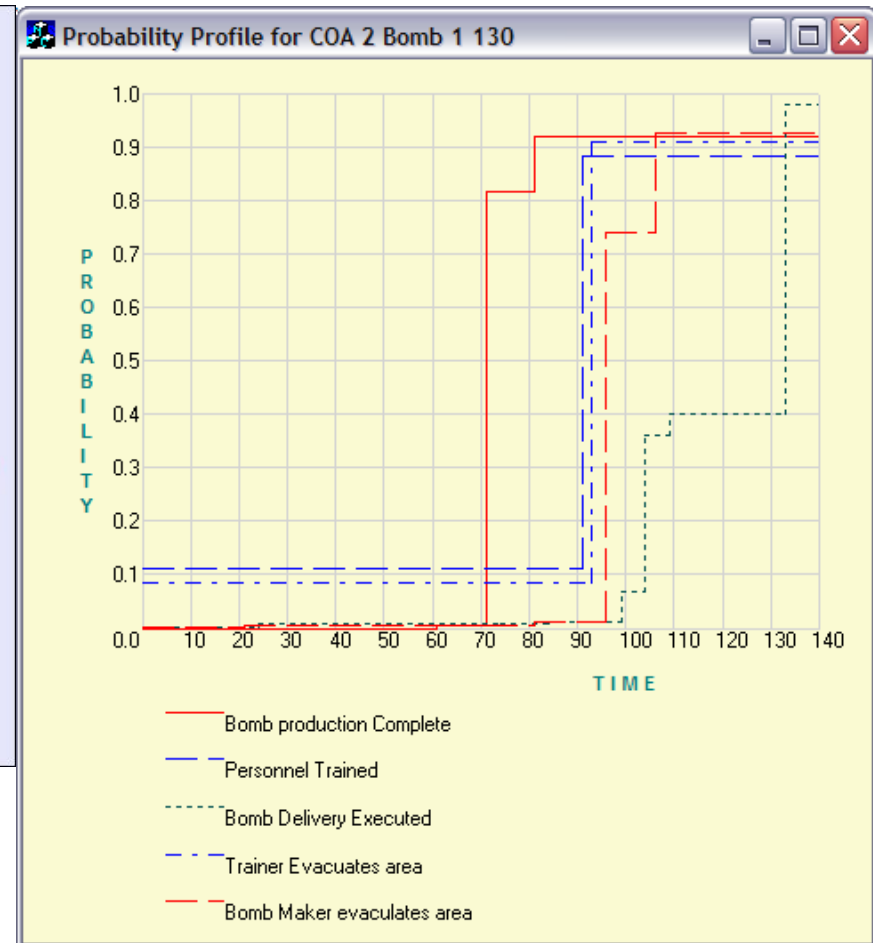
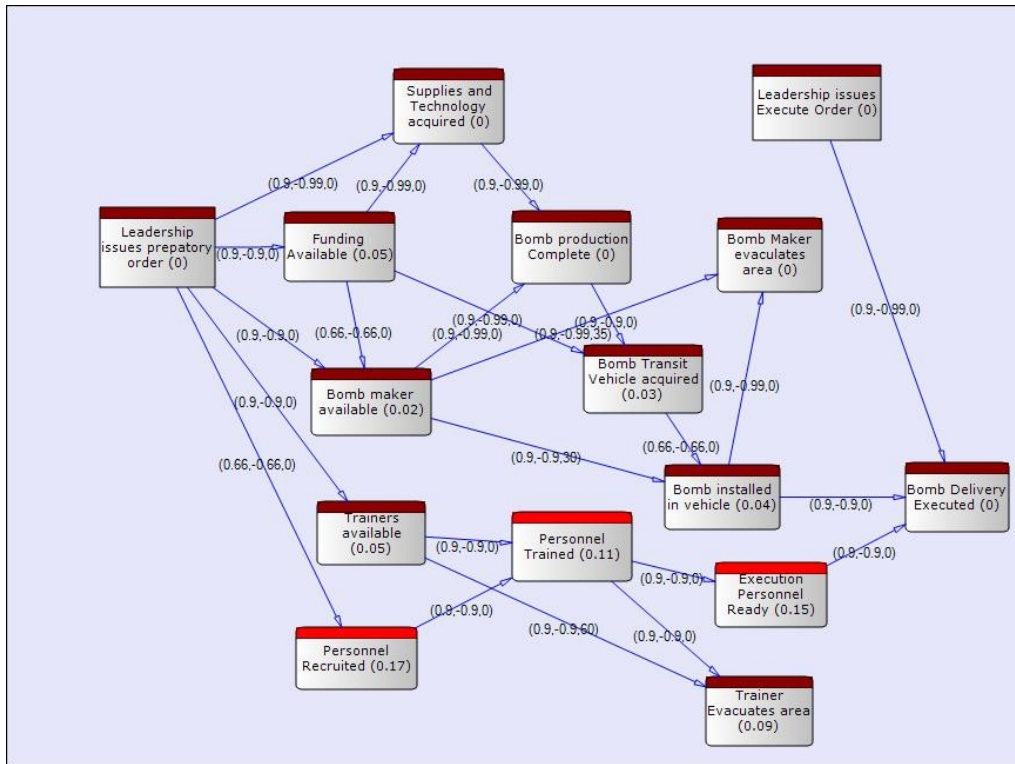
Command



# Adversary Model of Plan (Based On SNA of Kenya Attack)

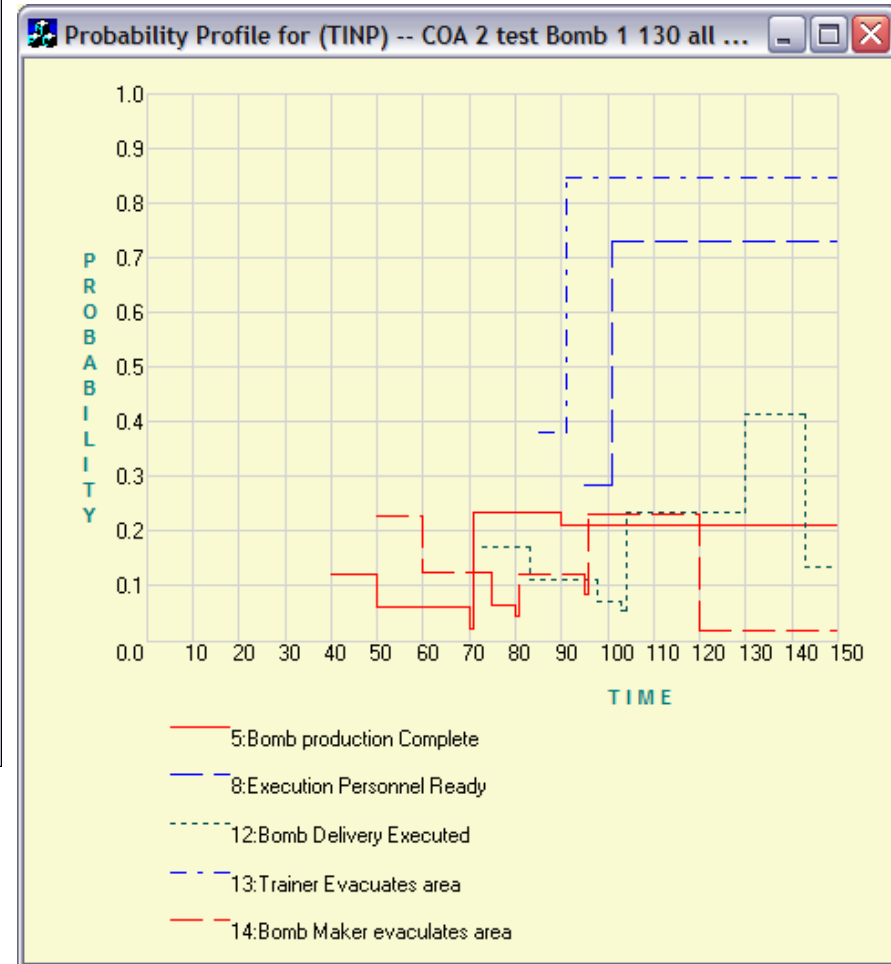
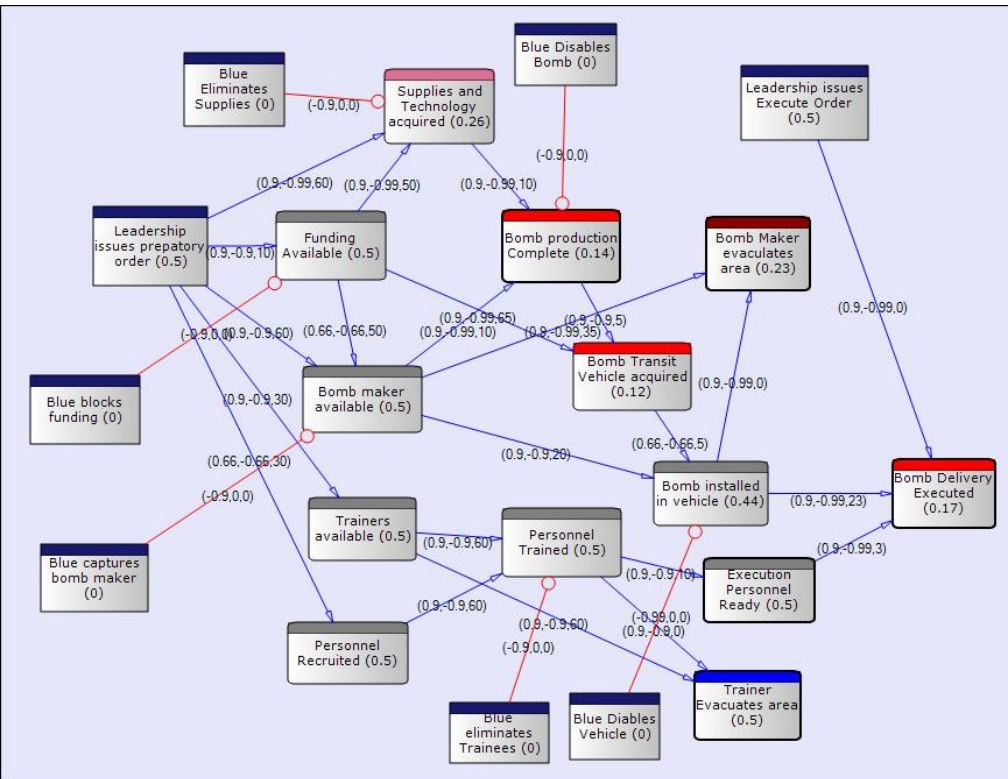


Model was created using Human to Human interoperation



- Derived from events and their timing as described in "Anatomy"
- The actors and their roles from the SNA and CAESAR 3 map to the events
- h and g values assigned based on understanding of TIN

# Adversary Model of Plan w/Blue Interventions



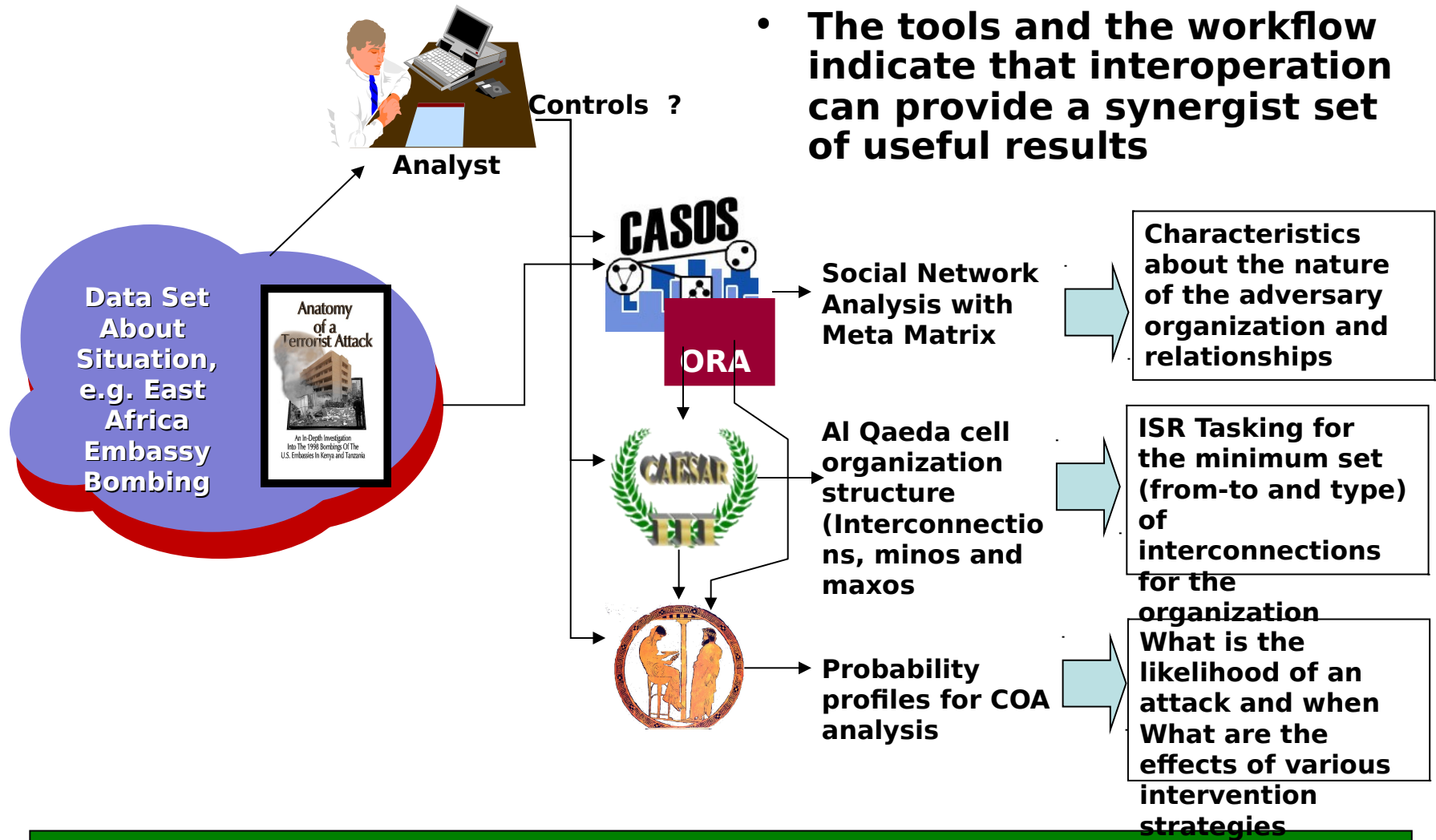
- **Hypothetical Blue actions (as might be perceived by the adversary) added**







# Demonstrate Potential



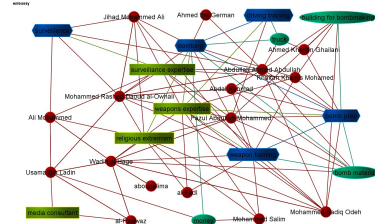
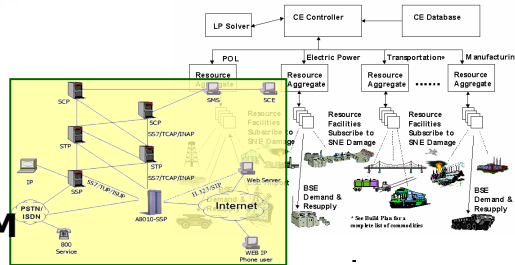
- **Given**
  - **Multiple Knowledge Representations**
  - **Multiple Reasoning/Computational Approaches**
  - **Modeling/Analysis Objective**
    - **A set of questions to be answered by the analyses performed on the computational models**
- **Solution**
  - **Identification of Model(s) and/or Combinations of Models that offer insight into the solution space**
  - **Workflow**

- **Nexus Between Models**
  - What *query* can be generated in one model that can be answered by the other?
  - What are the *overlaps* among the models?
  - How do we determine if the output of one is *supported* by the output of the other?
  - How do we identify *gaps*, *inconsistencies*, or *incompleteness* (need for more information)?
  - ...
- **Workflow**
  - Given an analysis objective, what is the workflow (i.e., combination, interactions, and sequence of/between models) that exploits the multi-modeling nexus in addressing the objective?

# Setup - Model View

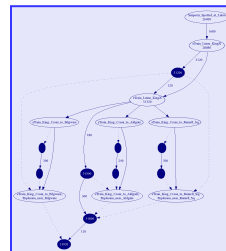
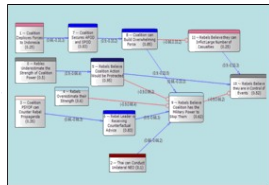


**Engineering System Models**  
E.g., Networks, CEM



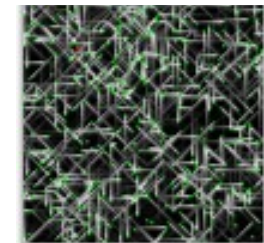
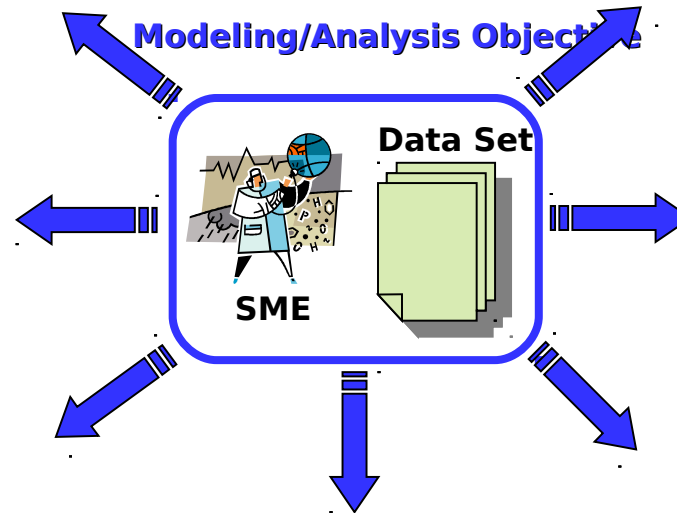
**Social Network Models**

**Situational Influence Models**  
E.g., Timed Influence Net



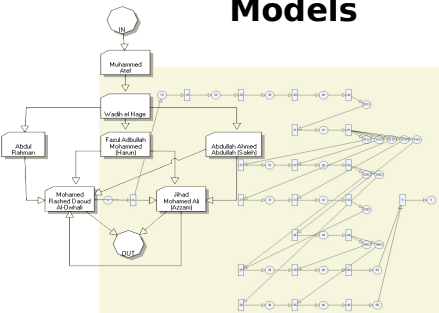
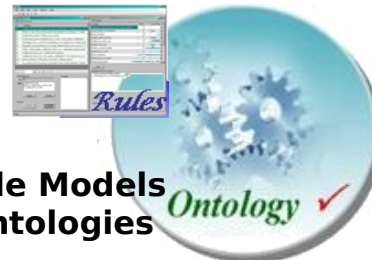
**Temporal Models**

**Modeling/Analysis Object**



**Multi-Agent Simulation Models**

**Rule Models Ontologies**



**Organization Models**



# Types of Results Achieved



- **Better Model Construction by:**
  - **Providing design parameters for the construction**
    - **e.g., Social Network to Organization structure.**
  - **Providing the structure (partially and/or completely)**
    - **e.g., Social Network to Timed Influence Net.**
- **Model Validation**
  - **Results from two models support each other**
    - **Multi-agent model and Social Network simulation models.**
- **Enhancements to analysis capabilities of a model by employing functionality from another**
  - **e.g., Temporal analysis of Timed Influence Net modes.**
- **Construction of new models by embedding multiple models in a single framework**
  - **e.g., Organization and Communication models.**

- **Three way interoperation between models has been demonstrated**
  - **One tool and its model can assist in the creation of a different model in another tool**
- **Used a combination of human “swivel chair” and data-to-data interoperation**
- **Process workflows are being developed.**
- **More effort needed to refine workflows and interoperation techniques**
- **Need to extend the approach to more models**